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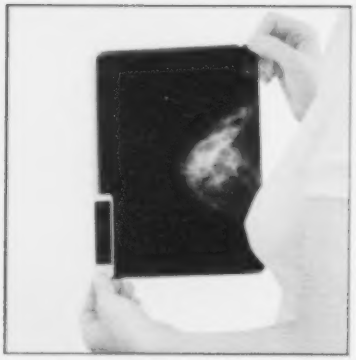
Article

An update on mammography use in Canada



by Margot Shields and Kathryn Wilkins

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Abstract

Background

This article updates mammography use by Canadian women aged 50 to 69, and reports trends from 1990 to 2008 among the provinces. Characteristics of non-users are examined.

Data sources and methods

Data from the 2008 Canadian Community Health Survey (CCHS) were used to update mammography use and to examine factors associated with non-use. Historical estimates were produced using the 2000/2001, 2003 and 2005 CCHS, the 1994/1995, 1996/1997 and 1998/1999 National Population Health Survey and the 1990 Health Promotion Survey. Frequency estimates, cross-tabulations and logistic regression analysis were used.

Results

In 2008, 72% of women aged 50 to 69 reported having had a mammogram in the past two years, up from 40% in 1990. The increase occurred from 1990 to 2000/2001; rates then stabilized. Between 1990 and 2000/2001, the difference in participation between women in the highest and lowest income quintiles gradually narrowed—from a 26- to a 12-percentage-point difference. In 2008, the disparity widened to 18 percentage points. Non-use was high in British Columbia, Prince Edward Island and Nunavut. Non-use was associated with being an immigrant, living in a lower income household, not having a regular doctor and smoking.

Interpretation

Despite widespread availability of screening programs, women in certain segments of the population are not receiving regular mammograms.

Keywords

breast cancer, cancer screening, mass screening, trends

Authors

Margot Shields (1-613-951-4177; Margot.Shields@statcan.gc.ca) and Kathryn Wilkins (1-613-951-1769; Kathryn.Wilkins@statcan.gc.ca) are with the Health Analysis Division at Statistics Canada, Ottawa, Ontario, K1A 0T6.

Breast cancer is the most common cancer among women, and will be diagnosed in an estimated 22,700 Canadian women in 2009. A woman's probability of developing breast cancer over her lifetime is 1 in 9.[1] The probability of dying from the disease is much smaller—1 in 28. The relative five-year survival for women with breast cancer is 87%—meaning that compared with women with similar characteristics but without breast cancer, those with breast cancer are 87% as likely to survive five years after diagnosis.[2]

The most important known risk factors are a family history of the disease, age and dense breast tissue—all of which are clearly beyond the control of the individual.[3,4] Although most evidence linking modifiable behaviours with breast cancer is weak, a recently published report concluded that there is a causal link between smoking and breast cancer incidence.[5]

While the benefits of breast screening are still being debated, evidence suggests that organized mammography programs contribute to reductions in breast cancer mortality, particularly among women aged 50 to 69.[6,7] Current Canadian guidelines recommend that women in this age group have a mammogram every two years.[8] Women in their 40s and those aged 70 or older are advised to talk to their doctor about the benefits of mammography.

By 1998, organized mammography screening programs existed in every province, in addition to facilities for diagnostic mammograms, which have long been available.[9] Organized breast cancer screening programs were introduced in Yukon in 1990 and in the Northwest Territories in 2003. As of 2009, Nunavut does not have an organized screening program.

All provincial/territorial screening programs offer a biennial mammogram to women aged 50 to 69 with no previous diagnosis of breast cancer. In some provinces, annual mammograms are available. As well, some jurisdictions

offer screening to women in their 40s and to those older than 69, but a physician's referral may be required.[9]

Probably because of improved case-finding as screening participation increased, incidence rates of breast cancer rose during the 1990s, but have been fairly stable since about 2000 (Figure 1). The death rate from female breast cancer began falling in the early 1990s—perhaps partly owing to earlier detection through screening. Between 1990 and 2009, the age-standardized mortality rate declined by 30%.[1]

Since 1988, when the first provincial program was launched in British Columbia, the number of women participating in organized mammography screening increased rapidly from 4,000 to 895,000 in 2004.[9] However, the use of mammography has not been uniform throughout the population.

Earlier studies based on data collected from Canadian women in the mid-1990s found that factors such as a lower level of education, residing in a rural area, not having a regular medical doctor, and being an immigrant were associated with lower levels of mammography use.[10-12] Now more than a decade later, when organized screening programs are well established and nearly universally available, it is even more important to identify barriers to use and groups among whom mammography use might be sub-optimal.

The aim of this study is to provide an update on mammography use by women aged 50 to 69 in Canada, and to report trends from 1990 to 2008 among the provinces. Estimates include not only mammograms conducted for screening, but also those for diagnostic purposes. Based on data from the 2008 Canadian Community Health Survey, characteristics of non-users are examined, including socio-demographic factors, contact with a medical doctor, and health-related risks. Barriers associated with non-use of mammography are reported.

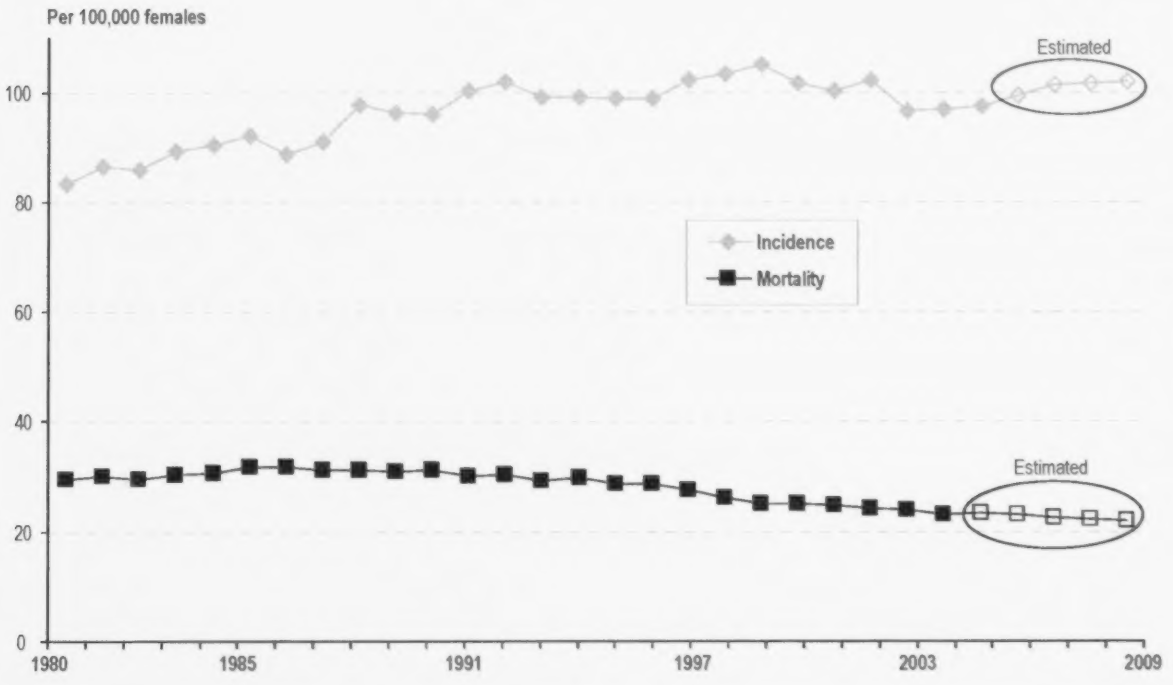
Throughout this article, the term "mammography user" refers to a woman who reported that she had undergone a mammogram within the past two years—the interval recommended in the Canadian Cancer Society guidelines; a "non-user" is one who had not had a mammogram within that period.

Methods

Data source

Data from the 2008 Canadian Community Health Survey (CCHS) were used to

Figure 1
Age-standardized† incidence and mortality rates of breast cancer, females, Canada, 1980 to 2009



† standardized to 1991 Canadian population
Note: Estimated data used for incidence in 2006 to 2009 and for mortality in 2005 to 2009
Source: Reference 1

estimate mammography use and to examine factors associated with being a non-user. The CCHS is cross-sectional, and covers the non-institutionalized household population aged 12 or older in all provinces and territories, except members of the regular Canadian Forces and residents of Indian reserves, Canadian Forces bases (military and civilian), and some remote areas. In 2008, the overall response rate was 75.2% (66,013 persons in the interviewed sample). A description of the CCHS methodology is available in a published report[13] and on Statistics Canada's website (www.statcan.gc.ca).

Historical estimates of mammography use are based on data from the 1990 Health Promotion Survey; the National Population Health Survey of 1994/1995, 1996/1997, and 1998/1999; and the CCHS of 2000/2001, 2003 and 2005.

Measures

Mammogram

The following questions were asked of female CCHS respondents aged 35 or older: "Have you ever had a mammogram, that is, a breast x-ray?" (Yes/No); "Why did you have it?" (open-ended; multiple responses accepted); and "When was the last time?" (Less than 1 year ago / 1 year to less than 2 years ago / 2 years to less than 3 years ago / 3 years to less than 5 years ago / 5 or more years ago).

Because of its lack of specificity, the question asking the reasons for having had a mammogram could be taken to refer to any that the respondent had ever had. Therefore, mammograms in the past two years cannot be identified as screening or diagnostic (to investigate a potential breast problem).

In the surveys used for estimates in the years before 2008, the questions about ever having a mammogram and the time of the last one were the same as in the 2008 CCHS. However, the question about reasons for having had a mammogram differed across surveys, and in some cases, it was not asked. As a result, this analysis focuses on mammography within the past two years, and necessarily includes both screening and diagnostic mammograms; women with a history of, or a current, breast problem are included.

Household income

Household income groups were derived based on a modified version of the equivalence score method, which adjusts household income by household size. This method was developed at Statistics Canada[14] and uses a weight factor based on the "40/30" rule. For each 2008 CCHS respondent, a household weight factor was calculated based on household size. The first household member was assigned a weight of 1; the second member, a weight of 0.4; and the third and all subsequent members, a weight of 0.3. The household weight factor was then calculated as the sum of these weights. For example, for a five-member household, it would be 2.3 (1 + 0.4 + 0.3 + 0.3 + 0.3). Household income was then divided by the household weight factor to derive income adjusted for household size. Using the entire weighted 2008 CCHS data file, the adjusted household incomes were grouped into quintiles (five groups, each containing one-fifth of the Canadian population). The same procedure was used to derive household income quintiles for all historical files used in the analysis.

Leisure-time physical activity

Three levels of leisure-time physical activity were derived, based on information from CCHS respondents about participation in physical activities in the three months before their interview. Levels were defined in terms of activity-specific kilocalorie expenditure per kilogram per day (KKD): active (3 or more KKD), moderate (1.5 to 2.9 KKD), and inactive (less than 1.5 KKD).

Level of day-to-day stress

Levels of day-to-day stress were estimated based on responses to the question, "Thinking about the amount of stress in your life, would you say that most days are: not at all stressful? not very stressful? a bit stressful? quit a bit stressful? extremely stressful?" The first two categories were defined as low stress; the third as medium stress; and the last two as high stress.

Sense of community belonging

To measure sense of community belonging, CCHS respondents were asked, "How would you describe your sense of belonging to your local community? Would you say it is: very strong? somewhat strong? somewhat weak? very weak?" In this analysis, sense of community belonging was used as an indicator of social support.

Analytical techniques

Frequency estimates were produced to describe the characteristics of the study population, based on weighted data to represent the female household population aged 50 to 69 in 2008. Cross-tabulations and multiple logistic regression modelling were used to examine factors associated with being a non-user of mammography. The variables included in the analysis were based on findings in the literature and availability in the CCHS.

It has been proposed that individuals with low socio-economic status are less likely to participate in cancer screening because of psychosocial factors such as lower levels of social support and higher levels of stress.[15] To explore this possibility, stress and community belonging were included in the bivariate analysis. Because neither factor was associated with non-use of mammography, they were not retained in the multivariate analysis. For the same reason, body mass index (BMI) was not retained in the multivariate analysis.

To reduce the potential for multicollinearity in the multivariate analysis, associations among the independent variables were examined. Education was excluded from the regression model because of its strong association with income. Country of birth was excluded because of its association with immigrant status.

To account for the survey design effects of the CCHS, standard errors, coefficients of variation, and 95% confidence intervals were estimated using the bootstrap technique.[16,17]

Differences between estimates were tested for statistical significance, which was established at the level of $p < 0.05$ (two-tailed).

Historical estimates of mammography use were based on data weighted to represent the female population aged 50 to 69 in the time period in which the data were collected. Because the age distribution of women in the 50-to-69 age group has shifted over time, historical rates were recalculated to standardize to the 2008 population, using 5-year age groupings. In each case, the crude and age-standardized rates were within one percentage point of each other (data not shown); therefore, only the crude percentages are presented.

Results

Characteristics of study population

The 2008 CCHS sample of 11,441 female respondents aged 50 to 69 was weighted to represent 3.8 million women in this age range (Table 1). The majority (71%) were married. Two-thirds lived in a Census Metropolitan Area. One-quarter were immigrants—19% had lived in Canada for 20 or more years; 4% for 10 to 19 years; and the remaining 2% for 0 to 9 years. Immigrants were predominantly from Europe and Asia. .

Around four-fifths (82%) reported that they had a regular medical doctor and had been in contact with a general practitioner or family doctor during the past year. Another 10% had a regular doctor, but had no contact in the past year. The remaining 8% reported that they did not have a regular doctor, although half of them (4%) had contacted a general practitioner or family doctor in the past year.

More than half (55%) of the women were postsecondary graduates. Excellent or very good health was reported by 54% of the women; only 16% reported fair or poor health

Trends in mammography use

In 1990, fewer than half (40%) of women aged 50 to 69 reported that they had had

Table 1
Selected characteristics of study sample,† female household population aged 50 to 69, Canada, 2008

Variable	Sample size	Estimated number (weighted) '000	Estimated percentage‡ (weighted)
Total	**11,441**	**3,829**	**100.0**
Age group			
50 to 54	2,932	1,202	31.4
55 to 59	3,207	1,079	28.2
60 to 64	2,978	875	22.9
65 to 69	2,324	673	17.6
Marital status			
Married/Common-law	7,059	2,708	70.8
Widowed	1,346	295	7.7
Divorced/Separated	2,009	556	14.6
Never married	998	263	6.9
Missing	29	...	...
Resides in Census Metropolitan Area			
Yes	4,967	2,531	66.1
No	6,474	1,299	33.9
Place of birth			
North America	9,694	2,862	76.2
Europe	978	411	11.0
Asia	338	320	8.5
Other	235	163	4.3
Missing	196	...	...
Years since immigration			
0 to 9	85	69‡	1.9‡
10 to 19	183	166	4.4
20 or more	1,383	698	18.6
Non-immigrant	9,581	2,814	75.1
Missing	209	...	...
Household income quintile			
1 (lowest)	2,259	624	19.6
2	2,131	653	20.5
3	1,897	656	20.6
4	1,613	564	17.7
5 (highest)	1,688	692	21.7
Missing	1,853	...	...
Education			
Less than secondary graduation	2,330	706	18.9
Secondary graduation	2,753	974	26.1
Postsecondary graduation	6,090	2,057	55.0
Missing	268	...	...
Has regular MD?—Contacted GP/family doctor in past year?			
Yes—Yes	9,266	3,147	82.2
Yes—No	1,211	378	9.9
No—Yes	481	157	4.1
No—No	474	146	3.8
Missing	9	...	...
Self-perceived general health			
Excellent/Very good	5,985	2,050	53.6
Good	3,546	1,178	30.8
Fair/Poor	1,890	594	15.5
Missing	20	...	...

† excludes 174 respondents with missing value for mammogram in past two years
‡ records with missing values excluded from denominators
‡ use with caution (coefficient of variation 16.6% to 33.3%)
... not applicable
Source: 2008 Canadian Community Health Survey

Table 2
Percentage reporting mammogram in past two years, by province, household income quintile and education, female household population aged 50 to 69, Canada excluding territories, 1990 to 2008

	1990	1994/1995	1996/1997	1998/1999	2000/2001	2003	2005	2008	Percentage-point change (2008 minus 1990)
	Percentage								
Canada	**40.5***	**56.9***	**63.1***	**66.2***	**72.7**	**72.4**	**72.0**	**72.5**	**32.0**
Province (year organized screening program began†)									
Newfoundland and Labrador (1996)	18.9*[E]	33.4*	43.3*	48.2*	64.1	66.6	69.9	71.4	52.6
Prince Edward Island (1998)	44.9*	67.0	67.2	62.5	71.2	70.7	64.8	61.0*	16.1
Nova Scotia (1991)	33.6*	42.8*	53.3*	56.1*	71.1	66.1	72.7	69.0	35.5
New Brunswick (1995)	28.6*[E]	49.0*	66.8	72.3	73.1	75.6	75.0	74.0	45.4
Quebec (1998)	39.8*	48.5*	56.9*	58.4*	74.2	72.8	74.0	73.9	34.1
Ontario (1990)	43.7*	59.6*	66.9*	68.2*	73.6	72.4	73.1	73.2	29.6
Manitoba (1995)	36.1*	42.9*	59.3*	65.2	71.1	72.6	66.7	71.0	34.9
Saskatchewan (1990)	21.1*[E]	71.4	66.1*	80.7	76.4	75.0	70.1*	73.6	52.4
Alberta (1990)	43.4*	70.5	63.1*	69.7	70.9	74.2	71.7	74.0	30.6
British Columbia (1988)	44.4*	67.8	70.4	75.8	69.0	72.0	67.1	67.9	23.5
Household income quintile									
1 (lowest)	32.7*	49.5*	52.8*	56.8*	66.4	63.7	66.5	60.7*	28.0
2	39.2*	46.2*	61.1*	66.2	69.2	71.8	71.0	71.0	31.8
3	43.4*	58.1*	61.3*	67.8*	75.4	74.6	75.2	77.5	34.1
4	44.7*	61.1*	68.1*	72.3	77.5	75.8	73.4*	77.0	32.3
5 (highest)	58.5*	68.5*	71.5*	71.7	78.4	77.8	75.7	79.1	20.6
Education									
Less than secondary graduation	36.2*	48.8*	57.7*	62.7*	68.4	67.0	68.3	63.9*	27.8
Secondary graduation or some postsecondary	43.3*	58.5*	64.8*	65.8*	72.4	73.0	72.7	74.5	31.2
Postsecondary graduation	46.0*	67.1*	67.2*	70.4*	76.4	75.5	73.3*	74.5	28.4

* significantly different from estimate for 2000/2001 (shaded) ($p < 0.05$)
† see reference 8
[E] use with caution (coefficient of variation 16.6% to 33.3%)
Sources: 2000/2001 to 2008 Canadian Community Health Survey; 1994/1995 to 1998/1999 National Population Health Survey; 1990 Health Promotion Survey.

a mammogram in the past two years; by 2008, the rate was 72% (Table 2). All of the increase occurred from 1990 to 2000/2001, after which the percentage stabilized.

In 1988, British Columbia implemented the first formal breast screening program, followed in 1990 by Ontario, Saskatchewan and Alberta. By 1998, programs were in place in all 10 provinces—accounting for the sharp increase in mammography use between 1990 and 2000/2001.[9]

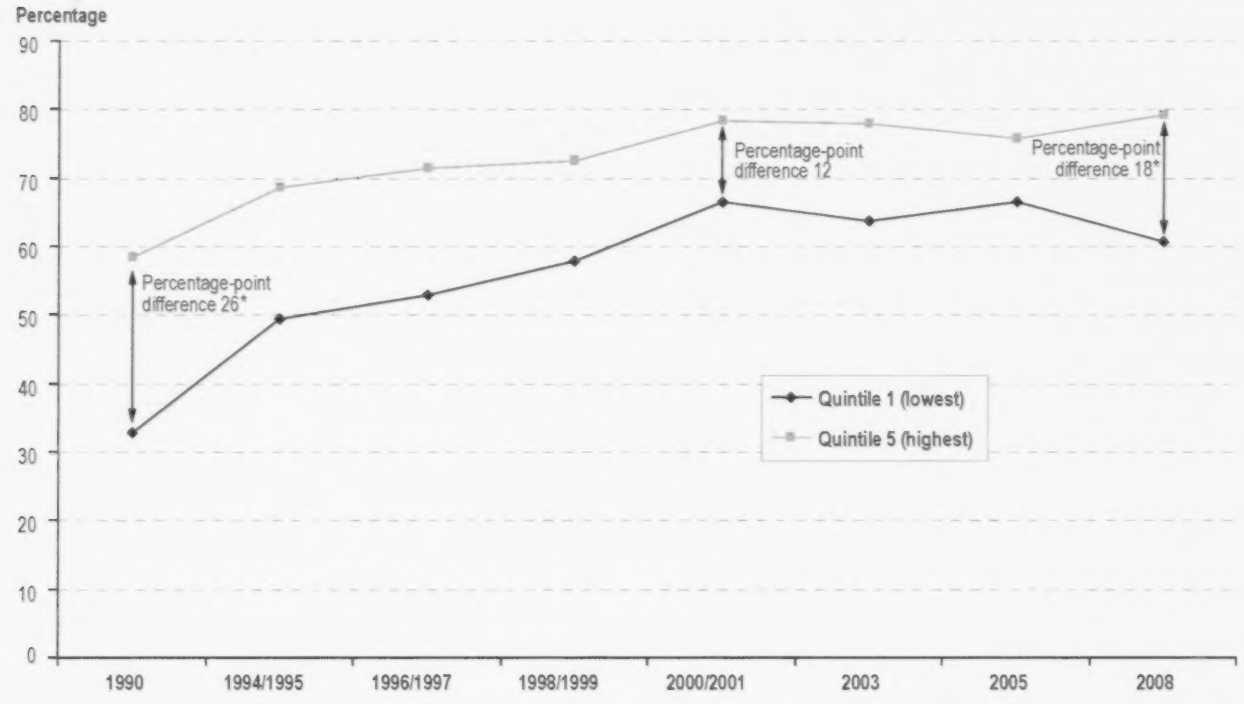
Before 2000/2001, mammography use varied substantially among the 10 provinces (Appendix Table A). In British Columbia, relatively high percentages of women reported mammography use, while in Newfoundland and Labrador and in Quebec, rates were lower, reflecting the later initiation of screening programs.[9] Disparities among the provinces were particularly wide in 1994/1995, with rates ranging from a low of 33% in Newfoundland and Labrador to a high of 71% in Saskatchewan, a difference of 38 percentage points. In 2000/2001, by which time all provinces had screening programs, the range had narrowed to 12 percentage points, and it remained about the same in subsequent years.

Lower income—Less use

In 1990, the percentage of women reporting mammography use was much higher in the highest household income quintile (58.5%) than in the lowest quintile (32.7%)—a 26-percentage-point difference (Figure 2). By 2000/2001, the difference had narrowed to 12 percentage points. However, in 2008, the gap widened to 18 percentage points, largely because of a decline in mammography use by women in the lowest income quintile. That year, 61% of women in the lowest income quintile reported mammography use, down from 67% in 2005 (Table 2). A similar decrease in 2008 was observed among women with less than secondary graduation.

Before the widespread implementation of screening programs, differences in mammography use between women in the middle and upper income categories were more pronounced. In 1990, 1994/1995 and 1996/1997, women in the middle income quintile had reduced odds of reporting mammography use, compared with those in the highest income quintile (Appendix Table B). Since 1998/1999, the odds that women in the middle quintile would use mammography have been similar to those of women in the highest quintile. By contrast, women in the lowest income quintile have had consistently lower odds of mammography use since 1990.

Figure 2
Percentage reporting mammogram in past two years, by highest and lowest household income quintile, female household population aged 50 to 69, Canada excluding territories, 1990 to 2008



* significantly larger than difference for 2000/2001 ($p < 0.05$)
Sources: 2000/2001 to 2008 Canadian Community Health Survey; 1994/1995 to 1998/1999 National Population Health Survey; 1990 Health Promotion Survey

Who hasn't had a mammogram?

Although mammography screening programs are widely available across Canada, 28% of women aged 50 to 69 reported in 2008 that they had not had a mammogram in the past two years (Table 3).

Women aged 50 to 54 were more likely to be non-users than were those aged 55 or older. The lower rate in the younger age group reflects the inclusion of 50-year-olds, who had had less time in the age range for which mammography is nationally recommended. When the percentage was recalculated for women aged 51 to 54, 28% were non-users—similar to the percentage of non-users in older age groups (data not shown).

Compared with women who were married or living common-law, those who were widowed, divorced, separated or never married were more likely to be non-users.

Women living outside a Census Metropolitan Area (CMA) were slightly, but significantly, more likely to be non-users (29%) than were CMA residents (27%).

In 2008, residents of Prince Edward Island and British Columbia were somewhat more likely to be non-users, compared with women living elsewhere. The percentage of non-users was particularly high in Nunavut (68%) where no organized mammography screening program has been developed.

Over half (57%) of recent immigrants —those in Canada for less than 10 years—were non-users, compared with 26% of Canadian-born women. Although this difference is substantial, recent immigrants aged 50 to 69 comprise just 2% of the female population in this age group. The likelihood of being a non-user was higher among those born in Asia (34%) or Europe (32%), compared with women born in Canada or the United States (26%).

Low socio-economic status (SES) was associated with higher non-use: 39% among women in the lowest household income quintile, compared with 21% among those in the highest quintile. Among women with less than secondary graduation, 36% were non-users, compared with 26% among those with at least secondary graduation.

Recent contact with a doctor was strongly associated with mammography use. While 23% of those who had a regular medical doctor and had contacted a general practitioner or family doctor in the past year were non-users, the figure was 71% for women without a regular

Table 3
Percentage not reporting mammogram in past two years, by selected characteristics, female household population aged 50 to 69, Canada, 2008

	Percentage	95% confidence interval from	to
Total	**27.5**	**26.1**	**28.9**
Age group			
50 to 54	32.8*	29.9	35.6
55 to 59	25.1	22.3	27.9
60 to 64	23.8	21.3	26.3
65 to 69†	26.9	23.8	30.0
Marital status			
Married/Common-law†	25.8	24.1	27.5
Widowed	32.6*	27.0	38.1
Divorced/Separated	30.9*	26.9	34.9
Never married	32.8*	28.2	37.4
Resides in Census Metropolitan Area			
Yes	26.7*	24.8	28.6
No†	29.2	27.7	30.8
Province/Territory			
Newfoundland and Labrador	28.6	22.1	35.0
Prince Edward Island	39.0*	30.5	47.4
Nova Scotia	31.0	25.4	36.5
New Brunswick	26.0	21.1	31.0
Quebec	26.1	22.9	29.3
Ontario	26.8	24.3	29.3
Manitoba	29.0	23.5	34.4
Saskatchewan	26.4	21.6	31.2
Alberta	26.0	21.6	30.5
British Columbia	32.1*	28.1	36.1
Yukon	33.8E	21.0	46.5
Northwest Territories	31.6E	17.1	46.0
Nunavut	67.8*E	41.5	94.1
Place of birth			
North America†	25.9	24.5	27.3
Europe	32.4*	27.9	36.9
Asia	34.4*	26.7	42.1
Other	29.0E	18.5	39.6
Years since immigration			
0 to 9	57.4*	40.1	74.8
10 to 19	34.9	24.1	45.7
20 or more	29.0	25.1	32.9
Non-immigrant†	25.8	24.4	27.2
Household income quintile			
1 (lowest)	39.3*	35.3	43.3
2	29.0*	25.7	32.3
3	22.6	19.3	25.8
4	23.0	19.7	26.4
5 (highest)†	20.9	17.8	24.1
Education			
Less than secondary graduation	36.1*	32.6	39.7
Secondary graduation	25.5	22.9	28.2
Postsecondary graduation†	25.5	23.7	27.3
Has regular MD?—Contacted GP/family doctor in past year?			
Yes—Yes†	22.8	21.3	24.2
Yes—No	45.3*	40.2	50.3
No—Yes	40.5*	31.5	49.5
No—No	70.7*	63.5	78.0
Self-perceived general health			
Excellent/Very good†	25.7	23.8	27.6
Good	29.7*	27.2	32.3
Fair/Poor	28.9	25.5	32.4
Level of day-to-day stress			
Low†	27.3	24.9	29.6
Medium	27.9	25.8	30.1
High	27.1	24.1	30.0
Sense of community belonging			
Very/Somewhat strong†	26.8	25.0	28.5
Very/Somewhat weak	29.0	26.5	31.5
Smoking status			
Daily smoker	39.8*	36.5	43.1
Occasional smoker	30.2	21.8	38.5
Non-smoker†	25.1	23.6	26.7
Leisure-time physical activity			
Active/Moderately active (1.5 or more KKD)†	25.5	23.6	27.3
Inactive (less than 1.5 KKD)	29.3*	27.2	31.3
BMI category			
Underweight (less than 18.5)	30.4	20.7	40.2
Normal weight (18.5 to less than 25)†	27.5	25.2	29.8
Overweight (25.0 to less than 30)	26.4	23.9	28.8
Obese class I (30.0 to less than 35)	27.3	23.7	30.9
Obese class II (35.0 to less than 40)	24.2	18.9	29.5
Obese class III (40.0 or more)	32.9	24.2	41.7

† reference category
* significantly different from estimate for reference category ($p < 0.05$)
KKD: kilocalories per kilogram per day
Note: For province/territory, the reference category is the other provinces/territories combined.
Source: 2008 Canadian Community Health Survey.

doctor and who reported no doctor contact over the past year.

Among the small percentage of women (8%) without a regular doctor, mammography use by usual source of care was estimated. Approximately half of women who usually sought care at an appointment or walk-in clinic, and 58% of those who usually go to a Centre local de services communautaires or a community health centre, were non-users (data not shown). Among women with no usual source of care, 78% were non-users.

Women who rated their health as good were slightly more likely to be non-users (30%) than were those who rated their health as excellent or very good (26%).

Neither perceived stress nor having a sense of community belonging was associated with being a non-user.

Of the three health risk factors considered, smoking and physical inactivity were correlated with non-use of mammography; no association with weight was observed. Daily smokers were substantially more likely to be non-users (40%) than were non-smokers (25%). Women who were inactive in their leisure time were slightly more likely to be non-users (29%) than were those who were active or moderately active (25%).

Factors associated with being a non-user of mammography were examined in a multivariate logistic model (Table 4). When other variables were controlled for, residing in a CMA, low household income, not having a regular doctor, and being a smoker remained significantly associated with non-use. On the other hand, associations with marital status, province/territory, self-perceived health and leisure-time physical activity level did not persist.

Reasons for not having a mammogram

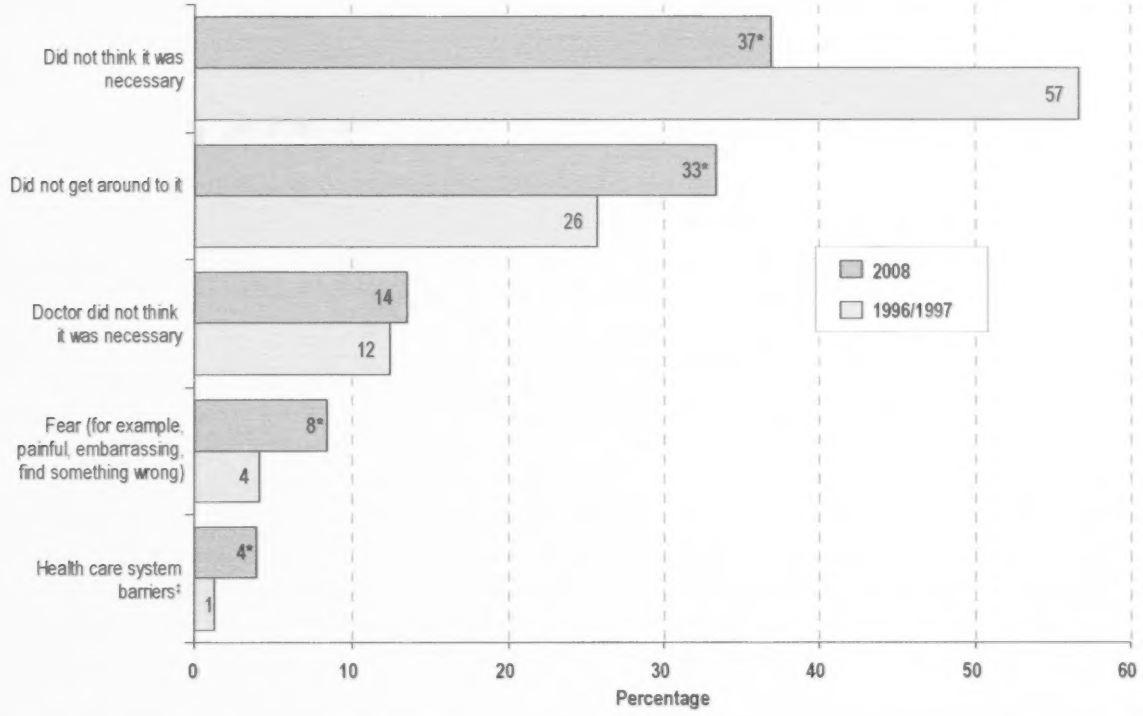
In the 2008 CCHS, women who reported that they had not had a mammogram in the past two years were asked why not. The most common reason, reported by 37% of non-users, was that they did not think it was necessary (Figure 3). A substantially

Table 4
Odds ratios relating selected characteristics to not reporting mammogram in past two years, female household population aged 50 to 69, Canada, 2008

	Unadjusted odds ratio	95% confidence interval		Adjusted odds ratio	95% confidence interval	
		from	to		from	to
Age group						
50 to 54	1.3*	1.1	1.6	1.4*	1.1	1.8
55 to 59	0.9	0.7	1.1	0.9	0.7	1.2
60 to 64	0.8	0.7	1.1	0.9	0.7	1.1
65 to 69†	1.0	...	...	1.0	...	...
Marital status						
Married/Common-law†	1.0	...	...	1.0	...	...
Widowed	1.4*	1.1	1.8	1.1	0.9	1.5
Divorced/Separated	1.3*	1.0	1.6	1.1	0.9	1.5
Never married	1.4*	1.1	1.8	1.1	0.8	1.4
Resides in Census Metropolitan Area						
Yes	0.9*	0.8	1.0	0.9*	0.8	1.0
No†	1.0	...	...	1.0	...	...
Province/Territory						
Newfoundland and Labrador	1.1	0.8	1.5	0.9	0.7	1.3
Prince Edward Island	1.7*	1.2	2.6	1.4	0.9	2.2
Nova Scotia	1.2	0.9	1.6	1.2	0.9	1.7
New Brunswick	1.0	0.7	1.3	0.9	0.6	1.2
Quebec	1.0	0.8	1.2	0.8	0.6	1.0
Ontario†	1.0	...	...	1.0	...	...
Manitoba	1.1	0.8	1.5	1.0	0.7	1.5
Saskatchewan	1.0	0.7	1.3	0.9	0.7	1.3
Alberta	1.0	0.7	1.3	0.9	0.7	1.2
British Columbia	1.3*	1.0	1.6	1.2	0.9	1.5
Yukon	1.4	0.8	2.5	1.2	0.6	2.4
Northwest Territories	1.3	0.6	2.5	0.6	0.2	1.3
Nunavut	5.7*	1.7	19.3	2.5	0.5	14.0
Years since immigration						
0 to 9	3.9*	1.9	7.8	3.7*	1.8	7.7
10 to 19	1.5	0.9	2.5	1.7	1.0	2.8
20 or more	1.2	1.0	1.4	1.3*	1.1	1.7
Non-immigrant†	1.0	...	...	1.0	...	...
Household income quintile						
1 (lowest)	2.5*	1.9	3.2	2.1*	1.6	2.9
2	1.5*	1.2	2.0	1.4*	1.1	1.9
3	1.1	0.8	1.5	1.1	0.8	1.4
4	1.1	0.9	1.5	1.1	0.8	1.4
5 (highest)†	1.0	...	...	1.0	...	...
Has regular MD?—Contacted GP/family doctor in past year?						
Yes—Yes†	1.0	...	...	1.0	...	...
Yes—No	2.8*	2.3	3.5	2.9*	2.3	3.7
No—Yes	2.3*	1.6	3.4	2.3*	1.6	3.5
No—No	8.2*	5.7	11.8	9.0*	6.0	13.5
Self-perceived general health						
Excellent/Very good†	1.0	...	...	1.0	...	...
Good	1.2*	1.0	1.4	1.1	0.9	1.3
Fair/Poor	1.2	1.0	1.4	1.0	0.8	1.3
Smoking status						
Daily smoker	2.0*	1.7	2.3	1.7*	1.5	2.1
Occasional smoker	1.3	0.9	1.9	1.2	0.8	1.9
Non-smoker†	1.0	...	...	1.0	...	...
Leisure-time physical activity level						
Active/Moderately active (1.5 or more KKD)†	1.0	...	...	1.0	...	...
Inactive (less than 1.5 KKD)	1.2*	1.1	1.4	1.1	0.9	1.3

† reference category
* significantly different from estimate for reference category ($p < 0.05$)
... not applicable
KKD: kilocalories per kilogram per day
Source: 2008 Canadian Community Health Survey

Figure 3
Most frequently reported reasons for not having mammogram in past two years, female household population aged 50 to 69,† Canada, 1996/1997 and 2008



† based on population who did not report mammogram in past two years
‡ includes not available at time required, not available in area, and waiting time too long
* significantly different from estimate for 1996/1997 ($p < 0.05$)
Note: Respondents could report more than one reason.
Sources: 2008 Canadian Community Health Survey, 1996/1997 National Population Health Survey

higher proportion (57%) of non-users had offered the same explanation in response to a similar question in the 1996/1997 NPHS. One-third (33%) of non-users in 2008 reported that they "had not gotten around to it"—up from 26% in 1996/1997. The percentages of non-users who reported that the doctor did not think it was necessary were similar in 2008 and 1996/1997, at 14% and 12%, respectively. In 2008, relatively few non-users mentioned fear or health care system barriers (8% and 4%, respectively), but these reasons had been reported even less frequently in 1996/1997.

Supplementary analysis focusing on non-users revealed an association between low SES and the belief that having a mammogram was unnecessary. Women in the lowest household income quintile and those with less than secondary graduation were more likely than those in higher income quintiles and with more education to report that they did not think a mammogram was necessary (data not shown). As well, 39% of daily smokers reported that they did not believe that mammography was necessary, compared with 30% of non-smokers.

Discussion

Since the implementation of breast screening programs in the late 1980s and the 1990s, mammography use among Canadian women has increased substantially. However, in 2008, more than one quarter of women aged 50 to 69 reported that they had not had a mammogram in the past two years—the interval recommended by the Canadian Cancer Society. The main factors associated with non-use were low SES, being an immigrant, not having a regular medical doctor, not having contacted a general practitioner or family doctor in the past year, and being a smoker.

The major strengths of the current study include the large, representative sample of Canadian women upon which it is based, and the up-to-date information it provides on factors associated with being a non-user of mammography—despite the nearly universal availability of breast screening programs.

What is already known on this subject?

- Evidence suggests that mammography contributes to reductions in mortality from breast cancer.
- Since the first provincial breast screening program was launched in 1988, rapidly increasing numbers of women have used mammography.
- Data collected in the mid-1990s indicate that use of mammography was not uniform throughout the population.

What does this study add?

- In 2008, 72% of women reported having mammography in the past two years—up from 40% in 1990.
- Mammography use peaked in 2000/2001.
- Before 2000/2001, rates differed markedly among the provinces; since then, provincial rates have become more similar.
- Mammography use in 2008 was less common at lower levels of income and education, and among immigrants, smokers, and those without a regular doctor.
- From 2005 to 2008, use of mammography declined among women at the lowest income level.

In the United States, the American Cancer Society[18] recommends an annual mammogram starting at age 40; in Canada, the recommendation is a biennial mammogram beginning at age 50. While the screening protocol in the United States calls for more frequent mammography that also begins at an earlier age, it is important to remember that not all women in that country have health care insurance. Despite these differences, in 2005, the most recent year for which comparable data are available, the percentages of women aged 50 to 69 who reported a mammogram in the past two years was similar: 72.5% in the United States[19] and 72.0% in Canada.

A slightly higher proportion of American than Canadian women were using mammography in 1994 and 2002/2003.[20,21] Similar to Canada, use of mammography in the United States increased dramatically between 1987 and 2000. However, in contrast to the stabilization of the mammography rate in Canada since 2000, the percentage of American women reporting they had had a mammogram in the past two years declined slightly between 2000 and 2005.[22]

The finding that low SES is associated with being a non-user of mammography is consistent with the results of earlier studies conducted in Canada and other countries.[10,11,20,23-26] Two models have been proposed to explain differences in cancer screening by SES. The psychosocial model proposes that low SES individuals are less likely to engage in health-protective behaviours including cancer screening because they experience more stress and receive less social support than do those at higher SES levels.[15] According to the cognitive model, beliefs about the risk of disease and the benefits of screening explain reduced levels of screening among low SES individuals. Findings from the CCHS data did not support the psychosocial model: stress and community belonging (used as a proxy for social support) were not associated with mammography use. Some support for the cognitive model emerged from supplementary analysis indicating that for non-users, reporting that mammography was unnecessary was significantly associated with both low income and low education.

A notable finding from this study was the decline in mammography use by low SES women as of 2008. This underscores an opportunity for informing women at all SES levels about the importance of regular mammograms.

Consistent with findings from the 2008 CCHS, reports of lower use of mammography among recent immigrants and women born in Asia have been published previously.[12,23,26,27] Lower use in these groups may reflect cultural sensitivities and differing attitudes about the mammogram procedure and its usefulness.

A fairly consistent report in the literature is that mammography use is associated with other preventive health behaviours such as regular exercise, being a non-smoker and contact with physicians.[25,26,28,29] This study found that women who were physically inactive in their leisure time and women who smoke were more likely to be non-users of mammography. It has been hypothesized that women who are unable or unwilling to quit smoking are generally less concerned about other health-promoting behaviours such as cancer screening.[26] A previous study found that although smokers and non-smokers were equally likely to receive a recommendation for a mammogram from their primary care physician, smokers were less likely to follow through. Furthermore, smokers were less likely to feel that mammography was necessary or beneficial,[30] a finding that was somewhat supported by the CCHS data. The low use of mammography among smokers is particularly relevant in light of a recently published review suggesting a causal link between smoking and breast cancer incidence.[5]

Having a usual source of care, recent contact with a physician, and receiving a recommendation from a physician have been found to be salient predictors of mammography use.[23,26,27,31] The strong association between mammography use and contact with doctors in this study supports the previous research and emphasizes the importance of the doctor's role in promoting the use of mammography.

Limitations

This analysis examines mammography use over the past two years and includes both screening and diagnostic mammograms. The extent to which trends in use and the characteristics

associated with being a non-user would differ if the analysis could be restricted to screening mammograms is unknown. It is likely that the vast majority of mammograms reported in 2008 were for screening. When asked why they had (ever) had a mammogram, 91% of 2008 CCHS respondents indicated reasons that were consistent with screening, and only 13% gave reasons consistent with diagnostic purposes.

Estimates of mammography use in the past two years are based on self-reported data, and responses were not validated against clinical records. A recent meta-analysis examined the accuracy of self-reported mammography.[32] Sensitivity (the percentage of women who reported having had a mammogram among those whose medical records showed that they had actually had one) was estimated to be 0.95. Specificity, however, was somewhat low (0.61), meaning that among women whose medical records indicated that they had not had a mammogram, 61% identified themselves as non-users; the remaining 39% incorrectly reported that they had had a mammogram. Over-reporting results partly from a phenomenon known as telescoping—that is, the date of the last mammogram is reported as being more recent than it actually was.[33] Social desirability bias may also result in over-reporting. As a result, it is likely that estimates of mammography use in this analysis are somewhat inflated.

The CCHS did not include a question about whether a doctor had recommended a mammogram. Previous research has indicated that advice from a physician is even more important than SES as a predictor of mammogram use.[31,32] Had it been possible to include such a variable in the multivariate analysis, the associations observed between other independent variables and non-use might have been attenuated.

Health behaviours such as participation in cancer screening are often examined using the theoretical framework proposed in the Health Belief Model.[34] According to this model, the likelihood of undergoing mammography is driven by subjective factors such as perceived susceptibility to and danger of breast cancer, and perceived benefits of and deterrents to mammography. The Health Belief Model is consistent with the argument proposed in the cognitive model that low SES individuals are less likely to engage in health-promoting behaviours because of lack of knowledge. An extensive analysis of mammography use by the components proposed in these models was not possible because of their unavailability in the CCHS, although some examination of the barriers to mammography was carried out by examining reasons for not having had a mammogram.

Conclusion

Mammography is one of the few steps a woman can take to reduce her risk of mortality from breast cancer. In 2008, 72% of Canadian women aged 50 to 69 had had a mammogram in the past two years—a figure that had remained unchanged from 2000/2001 when mammography screening programs were nearly universally available. Since 2000/2001, mammography use has been fairly similar across provinces. However, use is lower in identifiable sub-groups, namely, women with low SES, immigrants, smokers, and those without a regular doctor. ■

References

1. Canadian Cancer Society/National Cancer Institute of Canada. *Canadian Cancer Statistics 2008*. Toronto: 2009.
2. Ellison LF, Gibbons L. Survival from cancer—up-to-date predictions using period analysis. *Health Reports* (Statistics Canada, Catalogue 82-003) 2006; 17(2): 19-30.
3. Canadian Cancer Society. *Causes of Breast Cancer*. Available at: www.cancer.ca. Last modified January 7, 2009. Accessed April 28, 2009.
4. Friedenreich C, Aronson KJ, DeKoning K, et al. *Summary Report: Review of Lifestyle and Environmental Risk Factors for Breast Cancer* (Catalogue H39-586) Ottawa: Minister of Public Works and Government Services Canada, 2001.
5. Collishaw NE, Boyd NF, Cantor KP, et al. *Canadian Expert Panel on Tobacco Smoke and Breast Cancer Risk*. Toronto: Ontario Tobacco Research Unit, OTRU Special Report Series, 2009.
6. Tabár L, Yen MF, Vitak B, et al. Mammography service screening and mortality in breast cancer patients: 20-year follow-up before and after introduction of screening. *The Lancet* 2003; 361(9367): 1405-10.
7. Gotzsche.P.C., Nielsen M. Screening for breast cancer with mammography. *Cochrane Database of Systematic Reviews* 2006, Issue 4. Art. No.: CD001877. DOI: 10.1002/14651858. CD001877.pub2.
8. Canadian Cancer Society. *Early Detection and Screening for Breast Cancer*. Available at: www.cancer.ca. Last modified February 11, 2009. Accessed April 28, 2009.
9. Public Health Agency of Canada. *Organized Breast Screening Programs in Canada: Report on Program Performance in 2003 and 2004* (Catalogue HP32-1) Ottawa: Her Majesty the Queen in Right of Canada, 2008.
10. Gentleman JF, Lee J. Who doesn't get a mammogram? *Health Reports* (Statistics Canada, Catalogue 82-003) 1997; 9(1): 19-28.
11. Snider J, Beauvais J, Levy I, et al. Trends in mammography and Pap smear utilization in Canada. *Chronic Diseases in Canada* 1996; 17(3-4): 108-17.
12. Maxwell CJ, Bancej CM, Snider J. Predictors of mammography use among Canadian women aged 50-69: findings from the 1996/97 National Population Health Survey. *Canadian Medical Association Journal* 2001; 164(3): 329-34.
13. Béland Y, Dale V, Dufour J, et al. *The Canadian Community Health Survey: Building on the Success from the Past*. Proceedings of the American Statistical Association Joint Statistical Meetings 2005, Section on Survey Research Methods, August 2005. Minneapolis: American Statistical Association, 2005.
14. Carson J. Family spending power. *Perspectives on Labour and Income* (Statistics Canada, Catalogue 75-001-XIE) 2002; 10(3): 5-13.
15. Wardle J, McCaffery K, Nadel M, et al. Socioeconomic differences in cancer screening participation: comparing cognitive and psychosocial explanations. *Social Science and Medicine* 2004; 59(2): 249-61.
16. Rao JNK, Wu CFJ, Yue K. Some recent work on resampling methods for complex surveys. *Survey Methodology* (Statistics Canada, Catalogue 12-001) 1992; 18(2): 209-17.
17. Rust KF, Rao JNK. Variance estimation for complex surveys using replication techniques. *Statistical Methods in Medical Research* 1996; 5: 281-310.
18. American Cancer Society. *American Cancer Society Guidelines for the Early Detection of Cancer*. Available at: http://www.cancer.org/docroot/PED/content/PED_2_3X_ACS_Cancer_Detection_Guidelines_36.asp. Last modified May 3, 2008. Accessed April 28, 2009.
19. National Center for Health Statistics. *National Health Interview Survey (NHIS) 2005 Data Release*. Available at: http://www.cdc.gov/nchs/about/major/nhis/nhis_2005_data_release.htm. Last modified September 9, 2009. Accessed April 28, 2009.
20. Katz SJ, Zemencuk JK, Hofer TP. Breast cancer screening in the United States and Canada, 1994: socioeconomic gradients persist. *American Journal of Public Health* 2000; 90(5): 799-803.
21. Blackwell DL, Martinez ME, Gentleman JF. Women's compliance with public health guidelines for mammograms and Pap tests in Canada and the United States: an analysis of data from the Joint Canada/United States Survey of Health. *Women's Health Issues* 2008; 18(2): 85-99.
22. Breen N, Cronin KA, Meissner HI, et al. Reported drop in mammography: is this cause for concern? *Cancer* 2007; 109(12): 2405-9.
23. Breen N, Meissner HI. Toward a system of cancer screening in the United States: trends and opportunities. *Annual Review of Public Health* 2005; 26: 561-82.
24. Kim J, Jang SN. Socioeconomic disparities in breast cancer screening among US women: trends from 2000 to 2005. *Journal of Preventive Medicine and Public Health* 2008; 41(3): 186-94.
25. Rakowski W, Rimer BK, Bryant SA. Integrating behavior and intention regarding mammography by respondents in the 1990 National Health Interview Survey of Health Promotion and Disease Prevention. *Public Health Reports* 1993; 108(5): 605-24.
26. Schueler KM, Chu PW, Smith-Bindman R. Factors associated with mammography utilization: a systematic quantitative review of the literature. *Journal of Women's Health* 2008; 17(9): 1477-98.
27. Beaulieu MD, Béland F, Roy D, et al. Factors determining compliance with screening mammography. *Canadian Medical Association Journal* 1996; 154(9): 1335-43.
28. Fredman L, Sexton M, Cui Y, et al. Cigarette smoking, alcohol consumption, and screening mammography among women ages 50 and older. *Preventive Medicine* 1999; 28(4): 407-17.
29. Vernon SW, Laville EA, Jackson GL. Participation in breast screening programs: a review. *Social Science and Medicine* 1990; 30(10): 1107-18.
30. Messina CR, Kabat GC, Lane DS. Perceptions of risk factors for breast cancer and attitudes toward mammography among women who are current, ex- and non-smokers. *Women and Health* 2002; 36(3): 65-82.
31. Meissner HI, Breen N, Taubman ML, et al. Which women aren't getting mammograms and why? (United States). *Cancer Causes and Control* 2007; 18(1): 61-70.
32. Rauscher GH, Johnson TP, Cho YI, et al. Accuracy of self-reported cancer-screening histories: a meta-analysis. *Cancer Epidemiology Biomarkers and Prevention* 2008; 17(4): 748-57.
33. Paskett ED, Tatum CM, Mack DW, et al. Validation of self-reported breast and cervical cancer screening tests among low-income minority women. *Cancer Epidemiology Biomarkers and Prevention* 1996; 5(9): 721-6.
34. Janz NK, Champion VL, Strecher VJ. The Health Belief Model. In: Glanz K, Rimer BK, Lewis FM, eds. *Health Behavior and Health Education: Theory, Research and Practice*. San Francisco: Jossey-Bass, 2002: 45-66.

Appendix

Table A
Percentage reporting mammogram in past two years, by province, female household population aged 50 to 69, Canada excluding territories, 1990 to 2008

	1990	1994/ 1995	1996/ 1997	1998/ 1999	2000/ 2001	2003	2005	2008
	Percentage							
Canada	**40.5**	**56.9**	**63.1**	**66.2**	**72.7**	**72.4**	**72.0**	**72.5**
Province (year organized screening program began[†])								
Newfoundland and Labrador (1996)	18.9[‡]L	33.4L	43.3L	48.2L	64.1L	66.6L	69.9	71.4
Prince Edward Island (1998)	44.9	67.0	67.2	62.5	71.2	70.7	64.8L	61.0L
Nova Scotia (1991)	33.6	42.8L	53.3	56.1L	71.1	66.1L	72.7	69.0
New Brunswick (1995)	28.6[‡]L	49.0	66.8	72.3	73.1	75.6	75.0	74.0
Quebec (1998)	39.8	48.5L	56.9L	58.4L	74.2	72.8	74.0H	73.9
Ontario (1990)	43.7	59.6	66.9H	68.2	73.6	72.4	73.1	73.2
Manitoba (1995)	36.1	42.9L	59.3	65.2	71.1	72.6	66.7L	71.0
Saskatchewan (1990)	21.1[‡]L	71.4H	66.1	80.7H	76.4H	75.0	70.1	73.6
Alberta (1990)	43.4	70.5H	63.1	69.7	70.9	74.2	71.7	74.0
British Columbia (1988)	44.4	67.8H	70.4H	75.8H	69.0L	72.0	67.1L	67.9L
Highest province minus lowest province	**26.1**	**38.0**	**27.1**	**32.5**	**12.3**	**9.5**	**10.2**	**13.0**

L significantly lower than estimate for other provinces combined ($p < 0.05$)
H significantly higher than estimate for other provinces combined ($p < 0.05$)
[‡] use with caution (coefficient of variation 16.6% to 33.3%)
[†] see reference 8
Sources: 2000/2001 to 2008 Canadian Community Health Survey; 1994/1995 to 1998/1999 National Population Health Survey; 1990 Health Promotion Survey

Table B
Unadjusted odds ratios relating household income quintile to reporting mammogram in past two years, female household population aged 50 to 69, Canada excluding territories, 1990 to 2008

	1990	1994/ 1995	1996/ 1997	1998/ 1999	2000/ 2001	2003	2005	2008
	Unadjusted odds ratio							
Household income quintile								
1 (lowest)	0.3L	0.5L	0.4L	0.5L	0.5L	0.5L	0.6L	0.4L
2	0.5L	0.4L	0.6L	0.8	0.6L	0.7L	0.8L	0.6L
3	0.5L	0.6L	0.6L	0.8	0.8	0.8	1.0	0.9
4	0.6L	0.7	0.8	1.0	0.9	0.9	0.9	0.9
5 (highest)[†]	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

[†] reference category
L significantly lower than estimate for reference category ($p < 0.05$)
Sources: 2000/2001 to 2008 Canadian Community Health Survey; 1994/1995 to 1998/1999 National Population Health Survey; 1990 Health Promotion Survey